CONTENTS

	Page
True Nature of Spinach-Blight and the Relation of Insects to Its Transmission. J. A. McCLINTOCK and LOREN B. SMITH	1
Influence of Gypsum upon the Solubility of Potash in Soils. PAUL R. McMILLER	61
Correlation between the Percentages of Fat in Cow's Milk and the Yield. ELMER ROBERTS	67
Contribution to the Knowledge of Toxoptera graminum in the South. PHILIP LUGINBILL and A. H. BEYER	97
Can Biologic Forms of Stemrust on Wheat Change Rapidly Enough to Interfere with Breeding for Rust Resistance? E. C. STAKMAN, JOHN H. PARKER, and F. J. PIEMEISEL	111
Mineral Content of Southern Poultry Feeds and Mineral Requirement of Growing Fowls. B. F. KAUPP	125
Female Lepidoptera at Light Traps. W. B. TURNER	135
A Comparative Study of Salt Requirements for Young and for Mature Buckwheat Plants in Solution Cultures. JOHN W. SHIVE and WILLIAM H. MARTIN	151
Composition and Digestibility of Sudan-Grass Hay. W. G. GAESSLER and A. C. McCANDLISH	176
Water-Holding Capacities of Bedding Materials for Live Stock, Amounts Required to Bed Animals, and Amounts of Manure Saved by Their Use. J. W. WHISENAND	187
Two Important Introduced Parasites of the Brown-Tail Moth. C. F. W. MUESEBECK	191
A Hitherto-Unreported Disease of Okra. L. L. HARTER	207
Potato-Stem Lesions. H. A. EDSON and M. SHAPOVALOV	213
Anatomy of the Potato Plant, with Special Reference to the Ontogeny of the Vascular System. ERNST F. ARTSCHWAGER	221
Improved Methods of Immunization Against Symptomatic Anthrax (Blackleg). R. A. KELSER	253
Concentration of Symptomatic Anthrax (Blackleg) Toxin. WILLIAM N. BERG	263
Soil Reaction and the Growth of Azotobacter. P. L. GAINEY	265
Effect of Different Oxygen Pressures on the Carbohydrate Metabolism of the Sweet Potato. HEINRICH HASSELBRING	273
Influence of Humidity Upon the Strength and the Elasticity of Wool Fiber. J. I. HARDY	285
Availability of Potash in Some Common Soil-Forming Minerals and Effect of Lime Upon Potash Adsorption by Different Crops. J. K. PLUMMER	297
Influence of Reaction on Nitrogen-Assimilating Bacteria. E. B. FRED and AUDREY DAVENPORT	317

Page

Susceptibility and Resistance to Citrus-Canker of the Wild Relatives, Citrus Fruits, and Hybrids of the Genus Citrus. GEORGE L. PELTIER 337

Variation and Correlation in Wheat, with Special Reference to Weight of Seeds Planted. A. C. ARNY and R. J. GARBER 359

Obtaining Beet Leafhoppers Nonvirulent as to Curly-Top. C. F. STAHL and EUBANKS CARSNER 393

Acidity of Silage Made from Forage Crops. RAY E. NEIDIG 395

Pinon Blister-Rust. GEORGE G. HEDGCOCK, ELLSWORTH BETHEL, and N. REX HUNT 411

Comparative Toxicity of Cottonseed Products. W. A. WITHERS and F. E. CARRUTH 425

Variations in the Moisture Content of the Surface Foot of a Loess Soil as Related to the Hydroscopic Coefficient. FREDERICK J. ALWAY and GUY R. MCDOLE 453

Subsoiling, Deep Tilling, and Soil Dynamiting in the Great Plains. E. C. CHILCOTT and JOHN S. COLE 481

Overwintering of the Citrus-Canker Organism in the Bark Tissue of Hardy Citrus Hybrids. GEORGE L. PELTIER and DAVID C. NEAL 523

Resistance of Seeds to Desiccation. GEORGE T. HARRINGTON and WILLIAM CROCKER 525

Occurrence of Coccidioidal Granuloma (Oidiomycosis) in Cattle. L. T. GILTNER 533

Tissue Invasion by Plasmodiophora brassicae. L. O. KUNKEL 543

An Improved Method for Recovering Trypanosomes from the Blood of Rats for Antigen Purposes in Connection with Complement Fixation. F. H. REYNOLDS and H. W. SCHOENING 573

Life History of Pemphigus populi-transversus. THOMAS H. JONES and C. P. GILLETTE 577

Stem Lesions Caused by Excessive Heat. CARL HARTLEY 595

Work and Parasitism of the Mediterranean Fruit Fly in Hawaii during 1917. C. E. PEMBERTON and H. F. WILLARD 605

Corn-Rootrot and Wheatscab. G. N. HOFFER, A. G. JOHNSON, and D. ATANASOFF 611

Index 613

ERRATA

Page 60, legend to Plate A, line 4, "tugidity" should read "turgidity."

Page 62, Table I, column 6, line 3, under "Per cent," "48.3" should read "4.83."

Page 72, line 14, "standards deviations" should read "standard deviations."

Page 137, Table II, column 4, line 3, "69" should read "59."

Page 207, paragraph 3, line 10, "the specimens" should read "other specimens."

Page 252, legend to Plate 33, D, "×90" should read "×1,000."

Page 340, line 30, "Murreaa" should read "Murrea."

Page 358, Plates 50–51, the plate numbers should be interchanged.

Pages 373–376 (Tables iv–xi) and pages 381–384 (Tables xiv–xxi), the headings for the abscissae and the ordinates should be interchanged.

Page 610, lines 9 and 10, "This was the only point at which *O. humilis* had been established when the collections were made" should read "At this point only *O. humilis* had been established when the collections were made."

Page 611, lines 15 and 28, "*Gibberella* spp." should read "*Gibberella* sp."

ILLUSTRATIONS

PLATES

TRUE NATURE OF SPINACH-BLIGHT AND RELATION OF INSECTS TO ITS TRANSMISSION

PLATE A. 1.—A typical blighted Savoy spinach plant in the fifth stage of the disease. 2.—A healthy Savoy spinach plant ..... Page 60

PLATE 1. A.—*a*, A spinach plant killed by blight; *b*, an apparently healthy plant; *c*, *d*, and *e*, plants in progressive stages of the disease. B.—A spinach field near Norfolk, Va., in which scattered blighted plants occur.. 60

PLATE 2. A.—*a*, Upper surface of a spinach leaf affected with downy-mildew (cause: *Peronospora effusa*), showing the light areas which might be mistaken for early symptoms of spinach-blight. *b*, The under surface of a similar leaf. B.—Spinach leaves affected with Heterosporium leafspot... 60

PLATE 3. A.—A spinach leaf affected with anthracnose. B.—A spinach field showing blighted spinach plants killed by extreme cold 60

PLATE 4. A.—A spinach plant showing the first stage of the blight. B.—A spinach plant showing the sixth stage of the blight 60

PLATE 5. A.—Improved field cage for studying spinach-blight. B.—*a*, Seventh stage of spinach-blight; *b*, eighth stage of spinach-blight 60

PLATE 6. A.—Detail of the door construction of the improved field cage shown in Plate 5, A. B.—Cloth-covered wire cages, together with a large lantern globe, representative of the types of cage used for greenhouse experiments and for individual inoculations in the field cages 60

PLATE 7. A.—*1*, Spinach plant showing blotched appearance due to chlorosis. *2*, Typical fifth-stage blighted plant. *3*, Healthy plant. B.—*a*, Healthy spinach seedling pricked with a flamed needle as a control. *b*, A pot of seedlings inoculated with the virus of spinach-blight 16 days prior to the time this photograph was taken 60

PLATE 8. A.—*a*, A pot of spinach seedlings inoculated with virus-bearing aphids collected from blighted plants in the field. *b*, A pot of healthy seedlings which served as controls. B.—*a*, Healthy spinach seedlings used as a control. *b*, Spinach seedlings of the same age as the control, inoculated by needle pricks with the blight virus 60

PLATE 9. A.—Large area of blighted spinach on farm E, eastern Virginia. B.—Three spinach plants inoculated with virus-bearing *Macrosiphum solanifolii*, first instar 60

PLATE 10. A.—A blighted Viroflay spinach plant from Ohio. B.—Interior of cage 4, in which the aphids and blighted spinach plants were allowed to remain 60

PLATE 11. A.—Interior of cage 2. B.—Experimental plots 60

CONTRIBUTION TO THE KNOWLEDGE OF TOXOPTERA GRAMINUM IN THE SOUTH

PLATE 12. *Toxoptera graminum:* A.—Outdoor breeding shelter or insectary at Columbia, S. C., in which the cages were kept throughout the season. B.—An interior view of the same 110

CAN BIOLOGIC FORMS OF STEMRUST ON WHEAT CHANGE RAPIDLY ENOUGH TO INTERFERE WITH BREEDING FOR RUST RESISTANCE? Page

PLATE 13. *Puccinia graminis tritici:* A.—On seedlings of Bobs wheat (CI 5047). B.—On susceptible first-generation hybrid, Haynes Bluestem (Minnesota 169) × Kubanka durum wheat (CI 2094)..... 124

PLATE 14. *Puccinia graminis tritici:* A.—On seedlings of Haynes Bluestem inoculated with rust from the susceptible parent—that is, Haynes Bluestem. B.—On seedlings of Haynes Bluestem, the susceptible parent, inoculated with rust from the susceptible first-generation hybrid 16(2×3)1. C.—On seedlings of partially resistant durum parent, Kubanka (CI 2094), inoculated with rust from the susceptible parent, Haynes Bluestem (Minnesota 169). D.—On seedlings of partially resistant durum parent, Kubanka (CI 2094), inoculated with rust from the susceptible first-generation hybrid 16(2×3)1..... 124

PLATE 15. *Puccinia graminis tritici:* A.—Inoculations made on plants of susceptible second-generation hybrid of the cross emmer (Minnesota 1165)× Marquis. B.—Seedlings of the susceptible parent, Marquis, inoculated with rust from the susceptible second-generation hybrid 15(8×1)1. C.—Seedlings of the susceptible parent, Marquis, inoculated with rust from the stock cultures. D.—Seedlings of extremely resistant parent, emmer (Minnesota 1165), inoculated with rust from the stock cultures. E.—Seedlings of extremely resistant parent, emmer (Minnesota 1165), inoculated with rust from the susceptible second-generation hybrid 15(8×1)1..... 124

PLATE 16. *Puccinia graminis tritici:* A.—Susceptible second-generation plants from the cross Marquis × Kubanka (CI 2094), inoculated with rust from the stock cultures. B.—Seedlings of susceptible parent, Marquis, inoculated with rust from the susceptible second-generation plants shown in A. C.—Seedlings of partially resistant parent, Kubanka (CI 2094), inoculated with rust from the stock cultures. D.—Seedlings of partially resistant parent, Kubanka (CI 2094), inoculated with rust from susceptible second-generation plants shown in A..... 124

PLATE 17. *Puccinia graminis tritici:* A.—Seedlings of susceptible parent, Haynes Bluestem (Minnesota 169), inoculated with rust from stock cultures. B.—Seedlings of susceptible parent, Haynes Bluestem (Minnesota 169), inoculated with rust from the partially resistant F_9 hybrid (4×3)8AA shown in C. C.—Seedlings of partially resistant F_9 hybrid (4×3)8AA inoculated with rust from stock cultures. D.—Seedlings of partially resistant parent, Kubanka (CI 2094), inoculated with rust from stock cultures. E.—Seedlings of partially resistant parent, Kubanka (CI 2094), inoculated with rust from partially resistant F_9 hybrid (4×3)8AA shown in C..... 124

MINERAL CONTENT OF SOUTHERN POULTRY FEEDS AND MINERAL REQUIREMENTS OF GROWING FOWLS

PLATE 18. Feeding utensils used in the feeding experiments with chicks: *a*, Beakers for the sour skim milk; *b*, container for the dry mash; *c*, container for grit or shell; *d*, container for the grain mixture; *e*, container for the green feed; *f*, rape used as green feed..... 134

TWO IMPORTANT INTRODUCED PARASITES OF THE BROWN-TAIL MOTH

PLATE 19. A.—Large wooden cage used for rearing parasites from imported brown-tail-moth webs. B.—Large rearing tray with cloth bottom, designed by Mr. W. F. Fiske, and used for rearing *Apanteles lacteicolor* and *Meteorus versicolor* from brown-tail-moth caterpillars. C.—Small single-web rearing tray with paraffin-paper bottom..... 206

PLATE 20. *Apanteles lacteicolor:* A.—Adult female. B.—Egg. C.—Hibernating (first stage) larva, before (above) and after (below) evagination of hind intestine; *h*, hind intestine; *m*, place of attachment of midintestine to hind intestine; *a*, anal vesicle. D.—First-stage larva after feeding in spring, ready to pass into second stage; dorsal view: *a*, Anal vesicle. E.—Larval mandibles: Upper left, first stage; upper right, second stage; below, third stage. Page 206

PLATE 21. A.—*Apanteles lacteicolor:* Third-stage larva. Anal vesicle still present. B.—*A. lacteicolor:* Pupa. C.—Third-stage gipsy-moth caterpillar with cocoon of *A. lacteicolor*. D.—Two larvæ of an undetermined arctiid from the same egg mass: Above, parasitized by *A. lacteicolor;* below, unparasitized. E.—*Meteorus versicolor;* Third-stage larva. F.—*M. versicolor:* Pupa. G.—*M. versicolor:* Cocoons.

PLATE 22. *Meteorus versicolor:* A.—Adult female. B.—Egg. C.—Larva ready to issue from egg. D.—Larval mandibles: From top to bottom, first, second, and third stages. 206

A HITHERTO-UNREPORTED DISEASE OF OKRA

PLATE 23. A.—A pod of okra collected at Yarrow, Md., showing a typical spot caused by *Ascochyta abelmoschi*. B.—A typical podspot infection on the stem of okra. 212

POTATO-STEM LESIONS

PLATE 24. Potato-stem lesions four weeks after inoculation: A–H, Plants inoculated with *Rhizoctonia solani:* A, R. VII; B, C, E, *R. potomacensis;* D, Hyp. I; F, R. S.; G, R. VI; H, R. XVI. I–L, Plants inoculated with species of Fusarium: I, *F. solani;* J, K, *F. radicicola;* L, *F. trichothecioides*. 220

PLATE 25. Potato-stem lesions four weeks after inoculation: A–L, Plants inoculated with species of Fusarium: A, *F. discolor;* B, *F. oxysporum;* C–I, *F. eumartii;* E–H represent portions of the same plant, showing necrotic areas throughout the stem; J, *F. coeruleum;* K, *F. solani;* L, *F. discolor* var. *sulphureum*. M, Plant inoculated with *Botrytis* sp. I. 220

PLATE 26. Potato-stem lesions four weeks after inoculation with miscellaneous fungi: A, *Clonostachys* sp.; B, *Zygorhynchus* sp.; C, *Alternaria* sp. I; D, *Alternaria* (*Macrosporium*) *solani;* E, *Phoma* sp.; F, *Corethropsis* sp.; G, *Chaetomium* sp.; H, *Acrostalagmus* sp.; I–L, Control plants. 220

ANATOMY OF THE POTATO PLANT, WITH SPECIAL REFERENCE TO THE ONTOGENY OF THE VASCULAR SYSTEM

PLATE 27. Origin of leaf and branch traces of the potato: A.—Transverse section through internode of a partly mature stem. B.—Transverse section through a stem immediately below a node, showing the origin of a new trace at *a*. 252

PLATE 28. Origin of leaf and branch traces of the potato: A–D.—Transverse sections through successively higher nodal regions, showing the origin of the lateral leaf traces and of the branch trace. 252

PLATE 29. Distribution of tissues (primary) in the potato: A.—Transverse section of the central cylinder and the cortex, showing small stem bundle, extent and position of external and internal phloem, proto- and metaxylem, collenchyma and cortex, cambium, and pith. B.—Transverse section through part of large stem bundle showing fascicular cambium and medullary rays. C.—Transverse section through a large stem bundle. D.—Transverse section through somewhat older stem, showing interfascicular cambium and position of external phloem groups and endodermis. 252

Page

PLATE 30. Types of primary tissues of the potato: A.—Transverse section of part of large stem bundle showing sieve tubes and companion cells in outer phloem, type of cambium and medullary ray initials, metaxylem. B.—Transverse section through part of the same bundle showing inner phloem, pith, and cells of the perimedullary zone 252

PLATE 31. Types of primary tissues and elements of the potato: A.—Transverse section through interfascicular region of central cylinder showing cambium, outer phloem groups, and endodermis. B.—Transverse section through the same region showing internal phloem groups..... 252

PLATE 32. Types of elements of the potato: A.—Radial section of outer cortex, collenchyma, subepidermal layer, and epimeris with stomata. B.—Tangential section of part of vascular cylinder of partly mature stolon showing numerous sieve tubes and two porous vessels. C.—Tangential section of young stem showing sieve tubes of internal phloem and protoxylem. D.—Tangential section of partly mature stem showing cambium and medullary ray initials..... 252

PLATE 33. Distribution of tissues and type of elements of the potato: A.—Transverse section of large stem bundle at time of secondary growth showing distribution and type of medullary rays. B.—Transverse view of sieve plate of secondary sieve tube. C.—Transverse section through a large stem bundle showing type of cells of perimedullary zone and the extent of the latter. D.—Transverse view of sieve plate greatly enlarged. E.—Radial section through porous vessel, showing type of end wall and extent of pitting..... 252

PLATE 34. Distribution of tissues of the potato: A.—Tangential section through external phloem, showing branching and anastomosing of phloem groups. B.—Tangential section through internal phloem, showing branching and anastomosing of phloem groups..... 252

PLATE 35. Types and anastomosis of sieve tube of the potato: A.—Enlarged view of part of Plate 34, B, showing type of sieve tube. B.—Enlarged view through another region of the same figure, showing type and anastomosing of sieve tubes..... 252

PLATE 36. Distribution of tissues of the potato: A.—Transverse section of lateral bundle of mature petiole, showing distribution of external and internal phloem and amount and arrangement of xylem. B, D, E.—Cross sections through leaf blade at different stages of development, showing differentiation of palisade layer and spongy parenchyma. C.—Transverse section of tepiole, showing arrangement of vascular tissue, amount of cortex, and distribution of collenchyma..... 252

PLATE 37. Root of the potato in development: A.—Radial section through modal region of underground part of stem, showing origin of roots from the pericycle. B.—Transverse section of partly mature root. C.—Transverse section of a young diarch rootlet, showing arrangement of protoxylem and protophloem. D.—Transverse section of fully mature root..... 252

PLATE 38. Development of the tuber of the potato: A.—Section of mature stolon, showing general distribution and relative proportions of tissues. B.—Transverse section of part of vascular tissue of young tuber and cortex. C.—Transverse section of part of vascular tissue of a somewhat older tuber, showing the beginning of extensive cell division in perimedullary zone and parenchyma of outer phloem. D.—Transverse section of vascular tissue of partly grown tuber, showing the distribution of the phloem groups after a period of extensive growth in the perimedullary zone..... 252

PLATE 39. Development of the tuber of the potato: A–F.—Transverse sections through parts of tubers at successive stages of development, showing origin and development of the periderm..... 252

PLATE 40. Flower pedicel and stem node of the potato: A.—Transverse section through pedicel of flower. B.—Portion of transverse section through node, showing part of wing bundle of petiole above, part of stem bundle below, and leaf gap in center with connection of inner and outer phloem along the side of the stem bundle. Page 252

PLATE 41. Ontogeny of the potato: A.—Radial section of potato eye and part of mother tuber showing amount and position of procambium. B.—Transverse section through tip of potato stem, showing the general distribution of tissues, the amount of vascular tissue, and its arrangement into groups. C.—Transverse section through growing region of potato eye, showing the first visible differentiation of internal phloem groups. D.—Transverse section through tip of potato eye, showing the arrangement of the various parts and the beginning of vascular differentiation. 252

PLATE 42. Ontogeny of the potato: A.—Transverse section through potato sprout showing metaxylem and primary medullary rays. B.—Transverse section through part of growing region of potato sprout, showing position of the first formed protoxylem and the differentiation of the internal and external phloem groups from the procambium. C.—Transverse section through potato sprout, showing beginning of cambium development. D.—Transverse section through distal region of potato sprout, showing the first differentiation of internal phloem and protoxylem. 252

PLATE 43. Secondary growth of the potato: A.—Transverse section through nodal region of mature stem. B.—Transverse section through internode of mature stem. C.—Transverse section through mature petiole. 252

PLATE 44. Secondary growth of the potato: A.—Transverse section through part of large stem bundle, showing type of xylem and medullary ray cells. B.—Transverse section through interfascicular region of mature stem, showing the types of first and later formed secondary xylem elements. C.—Transverse section through part of mature root, showing secondary phloem. D.—Transverse section through part of mature petiole, showing secondary xylem. 252

PLATE 45. Secondary growth of the potato: A.—Transverse section through phloem of mature stem, showing most of the secondary elements to be sieve tubes and rays. B.—Transverse section through another region of mature stem, showing secondary phloem and rays. 252

PLATE 46. Condition of the primary phloem in mature stems of the potato: A.—Transverse sections through mature stem, showing primary phloem groups in interfascicular region. B.—Transverse section through the same region, showing primary internal phloem. 252

PLATE 47. Condition of primary phloem in mature stems of the potato: A.—Transverse section showing that most of the secondary phloem is made up of sieve tubes and ray cells. B.—Transverse section through mature stem, showing large internal phloem groups. 252

INFLUENCE OF HUMIDITY UPON THE STRENGTH AND THE ELASTICITY OF WOOL FIBER

PLATE 48. A.—A corner of the humidity room used to test wool fiber. B.—Records of the temperature and humidity during the experiment. 296

AVAILABILITY OF POTASH IN SOME COMMON SOIL-FORMING MINERALS—EFFECT OF LIME UPON POTASH ABSORPTION BY DIFFERENT CROPS

PLATE 49. A.—Oats, showing growth with potash from various minerals, with and without calcium carbonate. B.—Soybeans, showing growth with potash from various minerals, with and without calcium carbonate. C.—Rye, showing growth with potash from various minerals, with and without calcium carbonate. D.—Cowpeas, showing growth with potash from various minerals, with and without calcium carbonate. 316

70396°—20——2

SUSCEPTIBILITY AND RESISTENCE TO CITRUS-CANKER OF THE WILD RELATIVES, CITRUS FRUITS, AND HYBRIDS OF THE GENUS CITRUS — Page

PLATE 50. A.—*Citrus Medica*, citron of commerce (CPB 7768); B.—*Citrus grandis*, grapefruit (CPB 11170); C.—Thornton tangelo (CPB L-715 A); D.—*Citrus* sp., limon real 18 (CPB 7819) 358

PLATE 51. Results of Citrus-canker inoculations: A.—*Citrus* sp., "naranja," native orange (CPB 7929); B.—*Citrus grandis*, pummelo (CPB 7834); C.—*Citrus aurantifolia*, sour lime (CPB 7338); D.—*Cirtus* sp., talamisan (CPB 7827) 358

PLATE 52. Results of Citrus-canker inoculations: *A.—Citris mitis*, Calamondin orange (CPB 44305); B.—*Citrus* sp., Kansu orange (CPB 11242); C.—*Citrus Hystrix* (CPB 7872); D.—Limelo (CPB 40567B); E.—*Citrus nobilis* var. *unshiu*, Satsuma 358

PLATE 53. Results of Citrus-canker inoculations: A.—Citrumelo (CPB 4493); B.—Colman citrange (CPB 7896); C.—Cicitrange (CPB 48316A); D.—Citrandarin (CPB 40210); E.—Morton citrange (CPB 771A); F.—Faustrime (CPB 49819); G.—*Microcitrus australis* (CPB 7427); H.—*Citrus* sp., sweep lemon (CPB 1158); I.—*Citrus* sp., Davao lemon (CPB 7837); J.—Limequat (CPB 48787B) 358

PIÑON BLISTER-RUST

PLATE 54. Specimens from the type collection of the æcial stage (*Peridermium occidentale*) of *Cronartium occidentale* on *Pinus edulis* from Bayfield, Colo. . 424

PLATE 55. The æcial stage (*Peridermium strobi*) of *Cornartium ribicola* on *Pinus strobus* from Kittery Point, Me 424

PLATE 56. A young piñon tree (*Pinus edulis*) diseased with *Peridermium occidentale* in the pycnial stage, natural infection 424

PLATE 57. The uredinial and telial stages of *Cronartium occidentale* on *Ribes aureum* from the type material collected at Bayfield, Colo.; artificial inoculation 424

OVERWINTERING OF THE CITRUS-CANKER ORGANISM IN THE BARK TISSUE OF HARDY CITRUS HYBRIDS

PLATE 58. Citrus-canker spots on twigs from plants in the isolation field, inoculation on September 16, 1917. A.—Citrandarin (CPB 40175A). B.—*Poncirus trifoliata* (seedling, Alabama). C.—Savage citrange (CPB 7961). D.—Rusk citrange (CPB 7956A) 524

OCCURRENCE OF COCCIDIOIDAL GRANULOMA (OIDIOMYCOSIS) IN CATTLE

PLATE 59. *Coccidioides immitis:* A.—Camera-lucida drawing showing parasites from fresh pus in various stages of development. B.—Photomicrograph of of the hyphæ and spores from an old potato culture. C.—Photomicrograph of a nodule of spleen from a guinea pig, showing adult parasites lying free in granulation tissue 542

PLATE 60. *Coccidioides immitis:* A.—Photomicrograph of the lung of rabbit 1, showing nodules with many parasites. B.—Photomicrograph of a local lesion calf 184, showing large giant cells with parasite inclosed in one of them. C.—Photomicrograph of a local lesion calf 184, showing a ruptured sporulating form inclosed in large giant cell 542

TISSUE INVASION BY PLASMODIOPHORA BRASSICAE

PLATE 61. *Plasmodiophora brassicae:* A cabbage plant 3 months old; photographed six weeks after being inoculated at a single point on one side of the stem 572

PLATE 62. *Plasmodiophora brassicae:* Three clubs, each of which has resulted from the original infection of a small bit of tissue on one side of the stem.. Page 572
PLATE 63. *Plasmodiophora brassicae:* Some typical spindle-shaped clubs taken from cabbage plants grown in infected soil..... 572
PLATE 64. *Plasmodiophora brassicae:* A.—A longitudinal section through a young cabbage stem. Infection has taken place at two points on the stem and the swellings are about to fuse together. B.—A longitudinal section through a cabbage stem 11 days after inoculation of a single small spot on the stem..... 572
PLATE 65. *Plasmodiophora brassicae:* A.—A section through a cabbage stem 13 days after inoculation. B.—A section 15 days after inoculation..... 572
PLATE 66. *Plasmodiophora brassicae:* A.—A section through a cabbage stem 17 days after inoculation. B.—A section through a stem 19 days after inoculation..... 572
PLATE 67. *Plasmodiophora brassicae:* A.—A section through a cabbage stem 21 days after inoculation. B.—A stage in the infection of the cambium.. 572
PLATE 68. *Plasmodiophora brassicae:* A–B.—Both figures on this plate show cross section through cabbage stems that became infected when rather old. 572
PLATE 69. *Plasmodiophora brassicae:* A.—A longitudinal section through a cabbage stem that became infected after the vascular elements were well differentiated. B.—A section through one of the knoblike branch roots that are produced on infected roots..... 572
PLATE 70. *Plasmodiophora brassicae:* A.—A portion of a longitudinal section through the stem of a young cabbage plant. B.—What is believed to be a very early stage of cell-wall penetration. C.—An early stage in passage through a cell wall. D.—A little later stage than that shown in C. E, F.—Still later stages in the passage through cell walls. G.—Interesting because a nucleus is passing through the opening in the wall. H.—A case in which the opening made in the cell wall is unusually large. I.—Plasmodium passing through the end of a cell in the region of the cambium. J.—A case in which plasmolysis of the host cells seems to have broken a migrating plasmodium into two parts. K.—An ameba taken from a cambium cell. L, M.—Two small plasmodia that were found in cambium cells far from the point of original penetration. N.—Infected cambium cell..... 572
PLATE 71. *Plasmodiophora brassicae:* A.—A young shoot arising from a diseased lateral root of cabbage. B.—Two large diseased shoots coming from diseased tissue..... 572
PLATE 72. *Plasmodiophora brassicae:* A.—A section through a portion of an infected green cabbage leaf. B.—An infected shoot that is growing downward..... 572
PLATE 73. *Plasmodiophora brassicae:* Stages in the infection of medullary rays. A.—A rather large woody cylinder that is beginning to split apart through the abnormal growth of its medullary rays. B.—The woody cylinder of a cabbage root..... 372
PLATE 74. *Plasmodiophora brassicae:* A.—Somewhat later stages of medullary growth than those shown in Plate 73. B.—Another cylinder being split into two equal halves..... 372
PLATE 75. *Plasmodiophora brassicae:* A.—The wood of an old cabbage stem that is being split apart by medullary infection. B.—A somewhat later stage..... 372
PLATE 76. *Plasmodiophora brassicae:* A.—A longitudinal section through the woody part of a cabbage stem that has been split open by medullary infection. B.—A cross section of a young cabbage root..... 372

PLATE 77. *Plasmodiophora brassicae:* A.—Several xylem strands being forced apart by medullary infection. B.—A bundle that is beginning to be fan-shaped in cross section ..... Page 372

PLATE 78. *Plasmodiophora brassicae:* A.—A fibrovascular bundle that is almost semicircular in cross section. B.—A strand that is almost circular in cross section 372

PLATE 79. *Plasmodiophora brassicae:* Distribution of the parasite in the tissues of two different clubs at the time of spore formation. A.—30.9 per cent of the surface of the photograph is occupied by spore masses. B.—28.8 per cent of the photograph is occupied by these masses 372

PLATE 80. *Plasmodiophora brassicae:* Tissues from two other clubs—A.—28.8 per cent of the photograph is occupied by the spore masses. B.—An unusual distribution of the parasite 372

LIFE HISTORY OF PEMPHIGUS POPULI-TRANSVERSUS

PLATE 81. *Pemphigus populi-transversus:* A.—Young fundatrix, first instar. B, a. b, c.—Beginning of galls on cottonwood leaves. C.—Adult fundatrix with cottony secretion removed. D.—Winged sexupara from roots of Brussels sprouts. E.—Wingless virgogene from roots of Brussels sprouts. F.—Male. G.—Oviparous female. H.—Antenna of fundatrix. I.—Antenna of wingless viviparous female from Brussels sprouts. J.—Antenna of winged fundatrigenia from gall. K.—Antenna of winged sexupara from Brussels sprouts 594

PLATE 82. *Pemphigus populi-transversus:* A.—Gall on poplar cutting. B.—Gall shown in A, enlarged to nearly natural size 594

PLATE 83. *Pemphigus populi-transversus:* Variation, in size of galls and location on leaf petioles of *Populus deltoides*, Baton Rouge, La., September 15, 1916 594

PLATE 84. A.—Gall of *Pemphigus populi-transversus*, lips not protruding. B.—Gall of *Pemphigus populi-transversus*, lip protruding. C.—Gall of *Pemphigus populi-ramulorum*. D.—Beginning of gall of *Pemphigus populicaulis*. E.—Full-grown gall of *Pemphigus populicaulis*. F.—Turnip seedlings, showing injury by *Pemphigus populi-transversus: a*, infested; *b*, control 594

PLATE 85. *Pemphigus populi-transversus:* F.—White cottony secretion at roots of Brussels sprouts due to presence of *Pemphigus populi-transversus* .. 594

TEXT FIGURES

TRUE NATURE OF SPINACH-BLIGHT AND RELATION OF INSECTS TO ITS TRANSMISSION

FIG. 1. Graph representing the average lengths of the various stages in the progress of spinach-blight 5

CORRELATION BETWEEN THE PERCENTAGE OF FAT IN COW'S MILK AND THE YIELD

FIG. 1. Graphs showing the averages of the milk yield for the different ages of cows 70

2. Graphs showing the averages of percentages of butter fat for different breeds of cows 70

CONTRIBUTION TO THE KNOWLEDGE OF TOXOPTERA GRAMINUM IN THE SOUTH

Page

FIG. 1. Graph showing comparative number of young of the individuals of *Toxoptera graminum* in the A series plotted against the date of birth of the individuals 98
2. Graph showing the comparative number of young of the individuals of *Toxoptera graminum* in the B series plotted against the date of birth of the individuals 99
3. Graph showing comparative number of young of the individuals of *Toxoptera graminum* in the C series plotted against the date of birth of the individuals 99
4. Graph showing comparative length of life of individuals of *Toxoptera graminum* in the A series plotted against the date of birth of the individuals 100
5. Graph showing comparative length of life of the individuals of *Toxoptera graminum* in the B series plotted against the date of birth of the individuals 101
6. Graph showing comparative length of life of individuals of *Toxoptera graminum* in the C series plotted against the date of birth of the individuals 101
7. Graph showing effects of temperature upon length of immature period of *Toxoptera graminum*, plotted against the mean date of the immature period 108
8. Same as figure 7, but in this diagram the average length of the immature period of *Toxoptera graminum* is plotted against the average temperature for that period 109

A COMPARATIVE STUDY OF SALT REQUIREMENTS FOR YOUNG AND MATURE BUCKWHEAT PLANTS IN SOLUTION CULTURES

FIG. 1. Diagrams showing relative yields of buckwheat tops 159
2. Diagrams showing relative yields of buckwheat roots 166
3. Diagram showing relative yields of buckwheat seeds 169

A HITHERTO-UNREPORTED DISEASE OF OKRA

FIG. 1. *Ascochyta abelmoschi:* A section through a pycnidium on the host showing the outer and walls, the sporophores, and pycnsopores 209
2. *Ascochyta abelmoschi:* A portion of the pycnidium shown in figure 1 ... 209
3. *Ascochyta abelmoschi:* A number of pycnospores, some of which are septated, showing the variations in shape and size 210

ANATOMY OF THE POTATO PLANT, WITH SPECIAL REFERENCE TO THE ONTOGENY OF THE VASCULAR SYSTEM

FIG. 1. *Solanum tuberosum:* Diagram showing the course of the vascular bundles in the stem and the mode of origin of the vascular supply of the leaves (longitudinal) 226
2. *Solanum tuberosum:* Diagrams illustrating the origin and course of the vascular supply of the flower 235
3. *Solanum tuberosum:* Diagram illustrating the mode or origin, orientation, and development of the vascular tissue of the stem 238
4. *Solanum tuberosum:* Diagrammatic drawings of a series of sections through hypocotyl showing the position of the primary xylem and phloem groups, the changes from exarch to endarch, and the behavior of the phloem 246

INFLUENCE OF HUMIDITY UPON THE STRENGTH AND THE ELASTICITY OF WOOL FIBER

Page

FIG. 1. Graphs showing the effect of humidity upon the tensile strength of the wool fiber 290
2. Graphs showing the effect of humidity upon the elasticity of the wool fiber 292

AVAILABILITY OF POTASH IN SOME COMMON SOIL-FORMING MINERALS—EFFECT OF LIME UPON POTASH ABSORPTION BY DIFFERENT CROPS

FIG. 1. Rate of growth of oats under similar conditions fertilized with double applications of potash minerals and calcium carbonate 305
2. Rate of growth of soybeans under similar conditions fertilized with double applications of potash minerals and calcium carbonate 307
3. Rate of growth of rye under similar conditions fertilized with double applications of potash minerals and calcium carbonate 309
4. Rate of growth of cowpeas under similar conditions fertilized with double applications of potash minerals and calcium carbonate 312

INFLUENCE OF REACTION ON NITROGEN-ASSIMILATING BACTERIA

FIG. 1. Graphs showing the buffer effect of the various constituents of mannitol medium 322

VARIATION AND CORRELATION IN WHEAT, WITH SPECIAL REFERENCE TO WEIGHT OF SEED PLANTED

FIG. 1. Graphs showing the frequency distribution of wheat plants for average height. 1914–1917 368
2. Graphs showing the frequency distribution of wheat plants for yield of kernels 368
3. Graphs showing the frequency distribution of wheat plants for number of culms 369
4. Graphs showing the frequency distribution of wheat plants for average weight of kernels 370
5. Graph showing regression for weight of seed and yield of kernels per wheat plant in 1914 377
6. Graph showing regression for weight of seed and yield of kernels per wheat plant in 1915 378
7. Graph showing regression for weight of seed and yield of kernels per wheat plant in 1916 380
8. Graph showing regression for weight of seed and yield of kernels per wheat plant in 1917 385

PIÑON BLISTER-RUST

FIG. 1. Outline sketch map showing the distribution of *Pinus edulis* and of *P. monophylla* in the United States 416

COMPARATIVE TOXICITY OF COTTONSEED PRODUCTS

FIG. 1. Graphs showing the toxicity of cottonseed meal and kernels to rats 429
2. Graphs showing the toxicity of various diets to rats 430
3. Graphs showing the toxicity of cottonseed flour to rats 434
4. Graphs showing the effect of cottonseed products on the growth of pigs 445
5. Graphs showing the effect of various diets on the growth of pigs 446

VARIATIONS IN THE MOISTURE CONTENT OF THE SURFACE FOOT OF A LOESS SOIL AS RELATED TO THE HYGROSCOPIC COEFFICIENT — Page

FIG. 1. Map of a portion of the United States, showing annual precipitation, evaporation from a water surface, and frequency of drouths in a 20-year period, 1895–1914, to indicate the especially favorable location of the Nebraska Agricultural Expermient Station for soil-moisture studies 454
2. Diagram showing daily precipitation at Lincoln, Nebr., during the latter part of tle record-breaking drouth of the spring of 1910 459
3. Diagram showing moisture conditions in the surface 6 inches of soil in three adjacent fields at the Nebraska Agricultural Experiment Station during and just at the close of the record-breaking drouth in the spring of 1910 460
4. Diagram showing daily precipitation at Lincoln during the season of 1912. The dates of sampling are indicated by asterisks 463
5. Diagram showing ratio of moisture content to hygroscopic coefficient in the surface foot of soil on three adjacent areas at the Nebraska Agricultural Experiment Station during the season of 1912. The data illustrate also the relation of the distribution of moisture to both the plant cover and the preceding weather 477

SUBSOILING, DEEP TILLING, AND SOIL DYNAMITING IN THE GREAT PLAINS

FIG. 1. Map of the Great Plains area, which includes parts of 10 States and consists of about 400,000 square miles of territory 485
2. Ratio of the yield for each crop at each station of plot E (subsoiled) to the mean of the yield of plot B (not subsoiled) and plot E (subsoiled) and the average of all crops at each station 501
3. Ratio of the yield for each crop at each station of plot E (subsoiled) to the mean of the yield of plot B (not subsoiled) and plot E (subsoiled) and the average of each crop at all stations 502
4. Diagram of plots in dynamiting experiment at Ardmore, S. Dak 512

TISSUE INVASION BY PLASMODIOPHORA BRASSICAE

FIG. 1. Diagram showing the course taken by the infecting plasmodia in a young cabbage root or stem 552
2. Diagram showing the course taken by the infecting plasmodia in cabbage roots or stems that become infected after vascular elements are differentiated 553

LIFE HISTORY OF PEMPHIGUS POPULI-TRANSVERSUS

FIG. 1. Diagram illustrating the seasonal history of *Pemphigus populi-transversus* at Baton Rouge, La 588

STEM LESIONS CAUSED BY EXCESSIVE HEAT

FIG. 1. Lesions on seedlings of *Pinus ponderosa:* Seedlings A and D were injured by the sun's rays condensed by a lens. B was injured by a hot wire, C by an incandesecent lamp, and E by the direct sun 596